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Early Flood Detection System using Android Application

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Abstract— **Early monitoring of the flood will help society to save a life but is very hard to detect flood. During the flood situation, water level increases and becomes more volatile as it reaches a higher and higher level. In this master's work, we are worked on early flood detection and let people know a flood is coming. In every city situated near rivers has jack well which is used for collecting water for different purpose like drinking, farming, etc. As the water in the river increases same will increase in the jack well, we used pressure mounted in a closed small diameter pipe which detects an increase in the pressure as the water level in the pipe increases and calculations are done to convert increase in pressure to water head(height). A similar setup the in nearby jack well and data(heights) is transferred using ZigBee data transmitting device.to the server, the station made up using the Raspberry pi. Server station collects all height and makes it average, then it compares it with previous flood data and detects the flood situation.**

Keywords:- ZigBee, flood monitoring, Android app, Jack well.

I. INTRODUCTION

Flood is a natural disaster which causes living as well as non-living entities belong to the environment. No one can totally uproot these natural calamities but the one thing human can do is to create a system which overcome this and to take action to prevent it. Human have taking lots of effort to take major action on flood prevention. The flood prediction network must be set up in rural regions but some limitations occurs like skilled manpower, money, power supply etc. It should be taken in account that when to develop such flood alert systems there should be well electrical power sources available. There are some flood monitoring systems available in developed countries, but it requires skilled manpower and experts to check and analyze real-time data. But this not probable in developing and underdeveloped countries.

A. What is Flood?

A flood is a land which is usually dry being submerged by an outpouring of water. What happens in flooding is an overflow of water from wate r bodies, such as it may happen due to a collection of rainwater on saturated soil in an area flood or a lake or river, resulting in some of that water overflowing its usual limits. The reason behind flooding is heavy rainfall, snow melting in high rate, dam overflowing or other water systems.

Sometimes flood can occur when flow of water is increased due to meanders or bends in way of water. The natural floodplains of rivers are the basis of the flood which often damages to businesses and home if they are in it. The people living nearby water resources like river or large lakes are large in numbers because, the land nearby water bodies are useful for farms and these people are dependent on farms also it provides easy travel access.

There are floods that develop gradually, while there are others, such as flash floods that can develop without visible marks of rain in just a few minutes. Moreover, floods can be confined, affecting a community, society or neighborhood, or the entire river basins.

The primary reason behind the creation of flood warning scheme is to intimate flood well in advance in order to control human losses by evacuating individuals to secure locations and also protect precious characteristics. Despite some harm due to system disadvantages. The proposed system introduces an early flood warning system which overcomes the disadvantages of studied systems.

II. LITERATURE REVIEW

There are various systems available for flood detection. Some systems [1][2] designed Android Application to inform people nearby riverside about flood alert so that delay can be avoided, which occurs in others system and system proposed in these projects is deployed in the dam. WSN is used in some systems to detect flood condition in the river [3]. The system proposed in [4] is used software tool for the mobile device which uses real-time information generated by CEOPS server and people can get text messages about flood alert [4] and web servers are used in systems to inform about alert [6]. GPRS and GIS map are used in some systems to predict flood condition [6][7].

Studying all these systems it implies that there are some drawbacks which we tried to overcome in the proposed system.

III. PROPOSED WORK

After studying various papers, it is observed that current systems have some drawbacks like internet dependency, delay

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to inform common man about flood situation, complex calculations, flood monitoring system placed in the dam which can be damaged during the flood and excessive power consumption by alert systems. In my project, I have tried to overcome these drawbacks. The proposed system is not dependent on mobile towers, working well even during the absence of internet, in less power consumption, the alert indication is directly sent to civilians hence delay is avoided and no complex calculations also system is placed in jack wells so that damage can be avoided. The flowchart of the proposed system is given below:

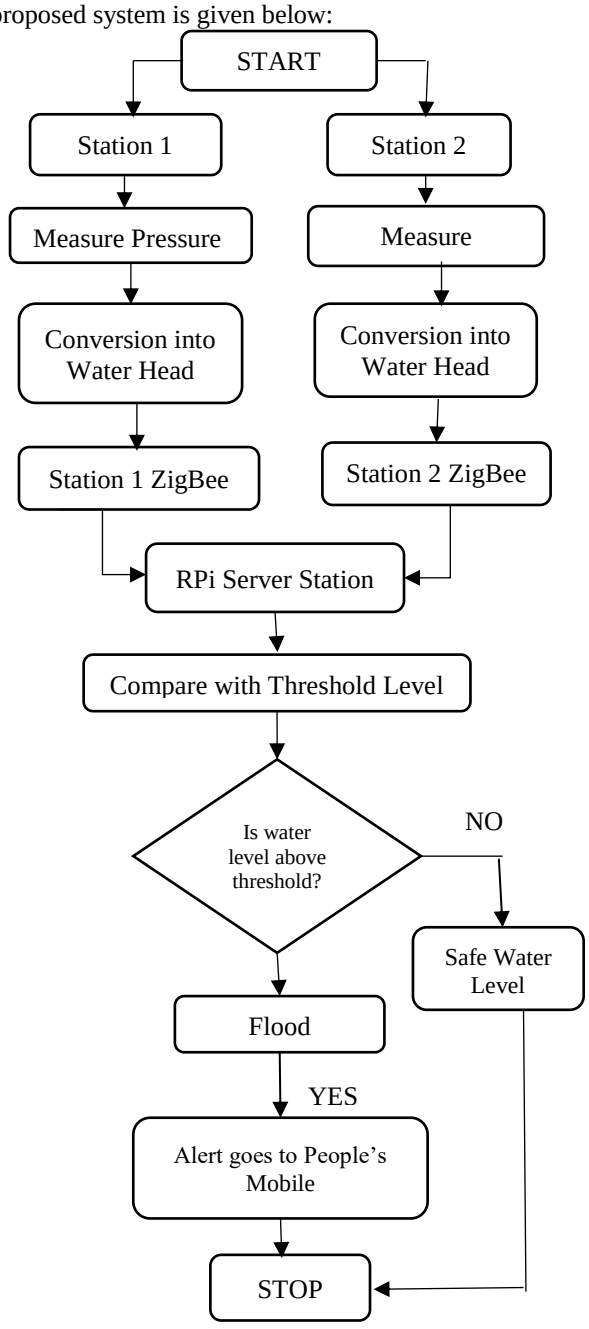

Fig. 1 Flow-chart of Proposed System

The proposed system has two stations one is transmitting station and another one is receiver station. Transmitter station includes pressure sensor which fixed on long length pipe and this sensor is connected to Arduino Uno. Also for data transmission ZigBee transceiver is used. The transmitter side station is placed in jack well. The pipe which has pressure sensor is placed in jack well and the station we can attach on the outer side of jack well.

At the receiver side, ZigBee transceiver is used to accept data and connected to Raspberry Pi. Gsm module is used here for sending SMS on mobiles of civilians.

For practical purpose, two stations are used. Actually, both station 1 and station 2 has the same working. The pressure sensor fixed on pipe (placed in jack well) senses pressure inside the pipe. As when water gets increases in the pipe, the pressure also increases. Whatever pressure sensed by the sensor is collected by Arduino Uno. It has a program which converts the pressure into water head in cm. This water level is sent and also received by ZigBee transceiver. At the receiver side, the received data is collected by a raspberry pi. It has Python coding which sets a threshold level of station 1 and station 2. This threshold level is nothing but a previous flood level and it is different for each station. Raspberry pi compares station 1 and station 2 water level with each of its threshold value. If the water level is above the threshold level, then it indicates a dangerous water level. There are two CSV files are created which has mobile numbers of civilians are stored. When dangerous level arises GSM module sends an alert message to mobiles of particular people. Two CSV files are for two stations. When a dangerous situation occurred at station 1 then GSM module sends message to people nearby station 1.

When an alert message comes on mobile phones that time the android application gets activated and it shows an alert on application. During this, the mobile gets vibrated and ring alert sound. So that common people also get to know the alert.

IV. TECHNIQUES

A. *ZigBee*

ZigBee is wireless device as it is transceiver hence acts as transmitter as well as receiver depending on application. It is low cost, compact device which can be used in isolated locations and radio environments.

ZigBee technology based on 802.15.4 IEEE standard that describes the layers of physical and MAC. ZigBee is a 802.15.4 specification superset.

With the remote wireless sensing and control applications expanding quickly, market size is projected to achieve hundreds of millions of dollars as soon as 2007. for many apps this makes ZigBee technology a very appealing proposal. The transmitting distance achieved by ZigBee from one station to another is 70 meters. However, the long distances greater than this also can achieve by data transfer from one node to another node in network topology. The ZigBee device mainly applied in areas where low throughput of data required. In remote areas, sensors with battery power and in low power applications ZigBees are used. The data is transferred in terms of packets. Maximum size of packet is 128 bytes while it allows payload of 104 bytes. This size can be varying according to applications supports in IEEE 802.15.4 standards. ZigBee are likely to be used should not require very high data rates.

It also has an optional super frame structure with a method for time synchronization. In addition to this, it is recognized that some messages need to be given a high

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priority. To achieve this, a guaranteed time slot mechanism has been incorporated into the specification. This enables these high priority messages to be sent across the network as swiftly as possible.
The Fig.1 shows different topologies of the ZigBee network.

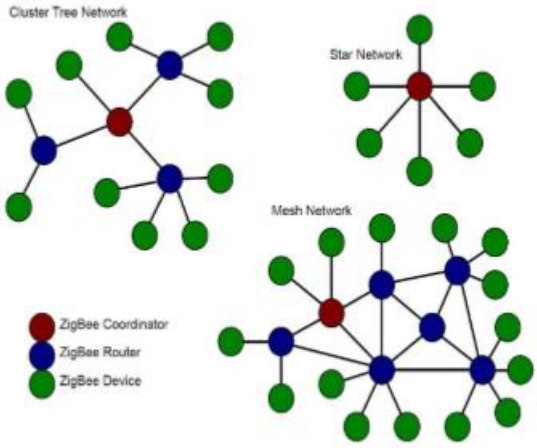

Fig. 2 ZigBee Network Topologies

From these, Star topology is used in the proposed system.

B. *GSM Module*

GSM/GPRS Modem-RS232 is built with Dual-Band GSM/GPRS engine- SIM900A works on frequencies 900/ 1800 MHz, the system has modem which supports RS232 interface and hence we can interface it with computer as well as microcontroller using MAX232 chip. The baud rate can be configured by AT command from 9600-115200. The **GSM/GPRS Modem** has an inner TCP/IP stack to allow you to connect via GPRS to the internet. It is helpful for sending mobile communication SMS, voice calling. The Regulated Power on-board enables you to connect a broad variety of unregulated power supplies. All things can be done by using simple AT commands. We can send SMS, use internet, do voice calling etc.

Fig. 3 GSM Module – SIM900A

C. *Android*

Android is a Google-designed mobile operating system. It is based on a modified Linux kernel version and is mainly intended for portable touchscreen applications such as smartphones and tablets.
The Android SDK offers the instruments and APIs needed to use the Java programming language to start developing Android platform apps. Android has a big developer community writing an application that expands device functionality. Over one billion applications are presently accessible for Android. The default user interface for Android is primarily based on direct manipulation, using loosely corresponding touch inputs to real-world behavior such as swiping, tapping, pinching, and reverse pinching to manipulate items on-screen along with a virtual keyboard. Bluetooth or USB supports Game controllers and full-size physical keyboards. The user input reaction is intended to be immediate and offers a fluid touch interface, often using the device's vibration capacities to provide the user with haptic feedback.

V. PROPOSED ARCHITECTURE

The block diagram of the proposed system is shown below:

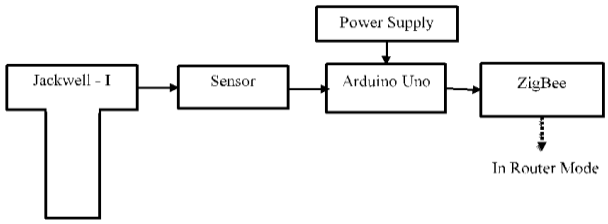

Fig. 4 Block Diagram of Station 1

The above block diagram is the same for station1 and station 2. The first block is for jack well and the second one is a sensor. Here the sensor is a pressure sensor that is BMP280. All things are controlled by microcontroller Arduino Uno. For power supply 230V supply is used and it is converted into 5V and 3.3V according to application. This conversion is done by the voltage converter module. At both stations, ZigBee is in router mode. That means we can increase the number of stations and for every station ZigBee will be in router mode. The sensor data is in pressure and this pressure is converted into water head by
following formula:

$$p = 0.0981 \times h \times sp.g$$

where,

h = head in meter
p = pressure in bar
$sp.g$ = specific gravity (generally 1)

The water level we get using this formula will be in cm. This will be done in Arduino programming. The threshold water level that is previous flood level is set in program and when the calculated water level reached above this threshold then alert will be announced.
The block diagram of the server end is shown in fig.5 below:

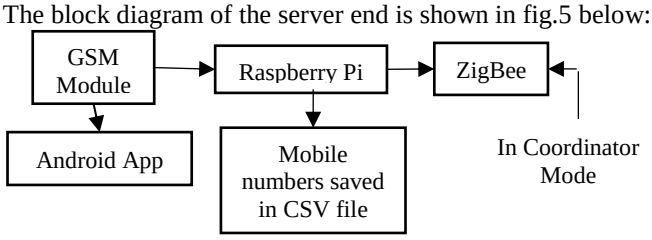

Fig. 5 Block Diagram of Server Station

As the above block diagram implies the server station. Here ZigBee is in coordinator mode. As Star topology is used. Here

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Raspberry pi microcontroller is used to collect water level data from ZigBee and compare it with a threshold value of particular station. Raspberry pi has CSV files in which mobile numbers of civilians of each station is stored. These CSV files are made in LibreOffice of Raspberry Pi. If a dangerous condition occurred at station 1 then GSM module will send message to mobiles station 1 civilian using CSV file of station 1. According to this server, the station will work. In Raspberry pi script the path of CSV file is given. Here the ZigBee transceiver takes data from station 1 and station 2 after a delay of 3 seconds.

VI. IMPLEMENTATION

A. Jack Well Model

For experimental purpose, long PVC pipes are used as jack well model. These pipes are of 4 feet long.

Fig. 6 Jack well Model

Jack well models are fixed on the stand to keep it stable.

B. Station 1 and 2 Model

The Fig.7 and Fig. 8 shows the Station 1 and Station 2 model. It has two LEDs, one is red and another one is green which indicates system ON/Off and data/calibration respectively. When the system gets ON the red LED will glow and when data transfer starts then green Led will ON. Below Red push button is used for calibrating data. Data calibration is nothing but to set the initial water level which is 0 cm for normal water level.

Here, both stations have same circuitry and same working. We can add more stations to predict the flood and all stations will be having same circuit structure inside. The 230V power supply is given to these stations which is converted by voltage regulator module according to each module power supply.

Fig. 7 Station 1 Model while System ON

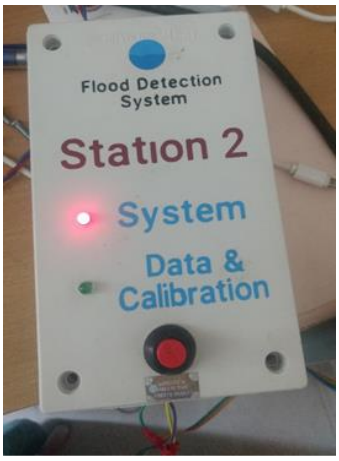

Fig. 8 Station 2 Model while System ON

C. Server Model

Fig. 10 and Fig. 11 showing outside and inside view of server station respectively.

Fig. 9 Server Station Model

The outside view of server station model shows 4 red LEDs which indicates System ON/Off, Station 1 ON/Off, Station 2 ON/Off and Alert. When the server gets On the first LED will glow. When station 1 or station 2 gets ON then the second and third LED will glow respectively. When a dangerous level occurred then Alert LED will glow.

The inside structure of server station includes Raspberry Pi B+ model with a GSM module and ZigBee connected to it. The charger module (white) is used for supply purpose.

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D. *Final Setup*

Fig. 10 Final System Setup

The final setup of the proposed system is shown in Fig.12. The station 1 and station 2 are attached on two jack well models. The pipes inside the jack wells having pressure sensors fixed on top inside the cap. Caps are stick with the solution to avoid air leakage. The middle one is a server station.

E. *Android Application*

The android application is made for civilians for alert purpose. Hence while making it the thing is to take in mind that common and uneducated people can also use it. So we made it user-friendly.

Fig. 11 Android App

Fig. 13 shows the initial page of the application. The name of the application is the Flood Detection System. Initially, it shows safe zone. When mobile gets message FLOOD then the app shows an alert message. The application is made by the MIT app inventor.

VII. RESULTS

A. *Case 1: At Normal Water Level*

At normal water level when calibration is done, the station 1 and station 2 indicates a green LED glows and the red LED will also glow for indicating the station is ON. On server station first System LED will glow indicating server station is ON and second or third or both Led will glow to show whether station 1 or station 2 or both stations are ON. Here the Alert LED is Off because the water level is normal. The following figure shows results on the server station.

Fig. 12 At Normal Level of Both Stations

Fig, 14 shows both stations are at normal water level.

B. *Case 2: At Dangerous Water Level*

At dangerous water level, there are three cases when station 1 is at a dangerous water level and when station 2 is at a dangerous water level and the last one is when both stations are at a dangerous level. The server station shows System, Station 1 and Alert LED will glow when station 1 is at flood condition and when System, Station 2 and Alert LED will glow if station 2 is at flood level. When server station shows System, Station 1, Station 2 and Alert LED will glow then it indicates both stations are at flood level. The following figures showing the outputs during these three cases:

Fig. 13 Station 1 is at Flood Condition

Fig. 14 Station 2 is at Flood Condition

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Fig. 15 Both Stations at Flood Condition

On Android Application when there is an alert condition then the alert message will display. The Android Application works on mobile message. When mobile gets the message of FLOOD then application shows "FLOOD IS COMING, RUN RUN". And during this, mobile gets vibrated and it sounds the alert alarm. The output on Android Application is showing below:

Fig. 16 Alert on Android Application

VIII. CONCLUSION

Flood is a natural disaster which cannot be predicted easily, but we worked on this cause and developed a system which tries to detect flood and give early intimation to nearby people. BMP280 pressure sensor situated at the transmitting station give water head in jack well by converting pressure for location 1. Such heights from the nearby location are collected and averaged at the server station which has the processing power of raspberry pi B+. Wirelessly data transmission is done by the ZigBee network which transfers the water head heights.

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